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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Root Development of Ponderosa Pine Transplants at Lincoln, Nebraska[1]

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Rapid, vigorous root development is a key factor in survival and establishment of nursery-grown trees after they are transplanted. In most environments occupied by ponderosa pine (Pinus ponderosa Laws.), drought, intensified by vegetative competition, restricts initial growth.

Young forest trees have numerous enemies: soil-inhabiting insects, burrowing rodents, foliage and stem insects, and browsing animals. If either top or root growth is slow, the feeding by enemies either above or below ground can be fatal. If root growth is rapid, however, accompanying top growth can be rapid and the impact of insect and mammal feeding will be minimized.

Recent root excavations at Lincoln, Nebraska, revealed that pine roots can grow rapidly after transplanting, if environmental conditions are favorable. Root systems of three young ponderosa pines were excavated and diagramed in August 1959. All three trees had been transplanted as bareroot, 2-1 stock from the Bessey Nursery (U. S. Forest Service) to a field test area on the campus of the College of Agriculture at Lincoln. Transplanting had been done in April of 1956, 1958, and 1959. The trees are hereafter referred to as 4-season, 2-season, and 1-season trees, even though 1959 growth was probably not complete at the time of excavation.

The soil was Wabash silt loam, fairly typical of the best medium- to heavy-textured, alluvial soils of southeastern Nebraska. The site was on the margin of a flat bottom that borders a small drainage. Free water was encountered at a depth of 6.3 feet during excavation.

After they were transplanted by the dug-hole method, the trees received no special care except two or three diskings per season

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to keep weeds down. The trees were given no supplemental water.

The root system of the 4-season tree was excavated by digging a straight access trench with one face tangent to the root collar. The vertical roots and some of the laterals were uncovered by digging away the wall of the trench with a trowel and ice pick. Other laterals were exposed by digging radial trenches outward from the root collar.

The less extensive root systems of the two younger trees were excavated by first removing the soil from around the lateral roots and then digging away the central column of earth containing the vertical roots.

The roots of each tree were diagramed to scale on coordinate paper as they were excavated. Vertical projections (figs. 1, 2, 3) show all roots as though oriented along a single vertical plane.

All three root systems contained two distinct kinds of roots. One group of roots penetrated almost vertically beneath the tree and apparently functioned as tap roots. A second group radiated out in all directions to form a strong set of laterals that generally remained within 2 feet of the soil surface.

Root development in the 1-season tree (fig. 1) was confined almost entirely to simple extension, with little branching. There was little difference between total elongation of vertical and lateral roots. In response to some unknown stimulus, two primary laterals turned downward rather abruptly and became "sinkers."

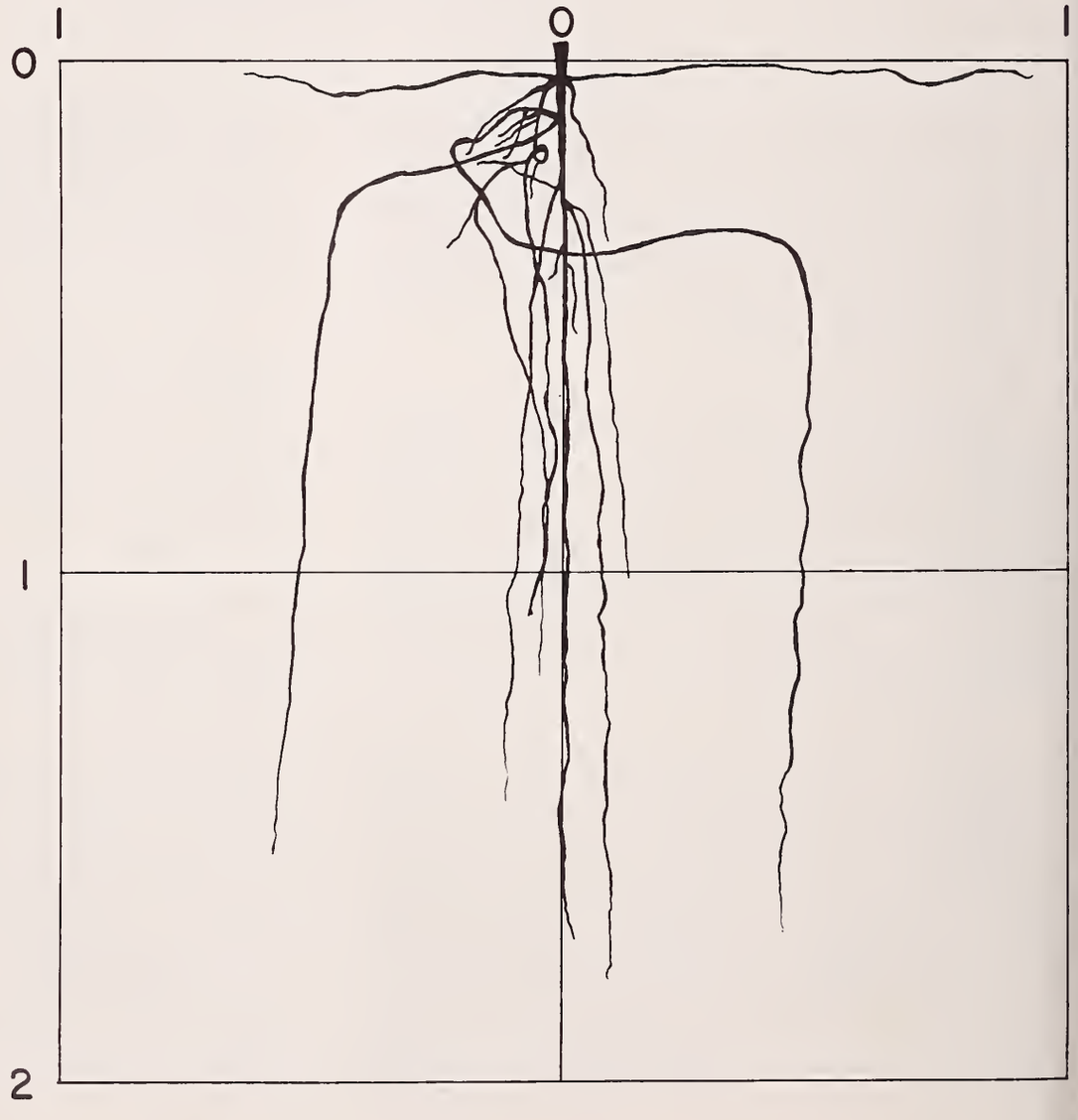

Figure 1.-- Vertical projection of root system of 1-season ponderosa pine. Grid units are feet.

The extensive root system of the 2-season tree (fig. 2) showed clearly that growth was rapid in the second year after transplanting. Numerous roots had emerged from near the root crown, 3 to 4 inches below the soil surface. Most of these grew downward to form a compact column of fine primary roots with many secondary branches. The remainder developed into laterals that were generally longer and somewhat thicker than the verticals, but had fewer branches. Two vertical roots that penetrated to within about a foot of the water table had many fine branches near their tips.

The root system of the 4-season tree (fig. 3) was similar in form to that of the 2-season tree. The strong central column of vertical roots had penetrated to the free water level and produced numerous branches to tap this water supply. One of the lateral roots was more than 13 feet long. At time of excavation this 4-season tree was about 30 inches tall.

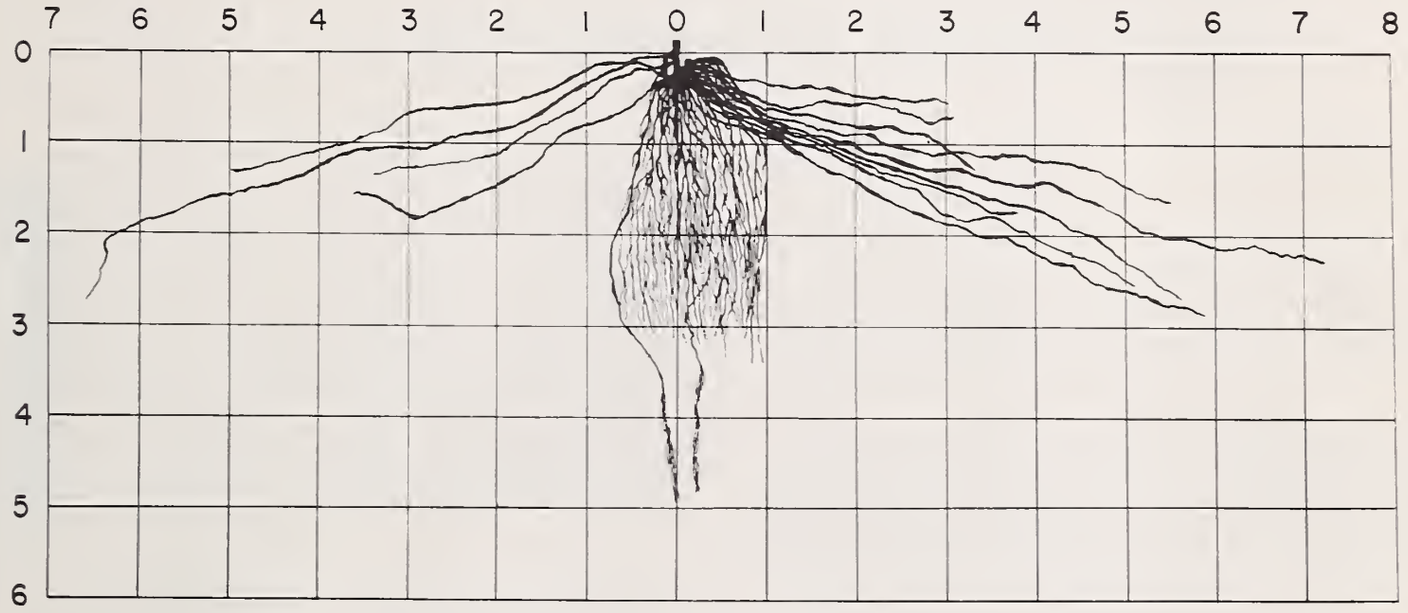

Figure 2.--Vertical projection of root system of 2-season ponderosa pine. Grid units are feet.

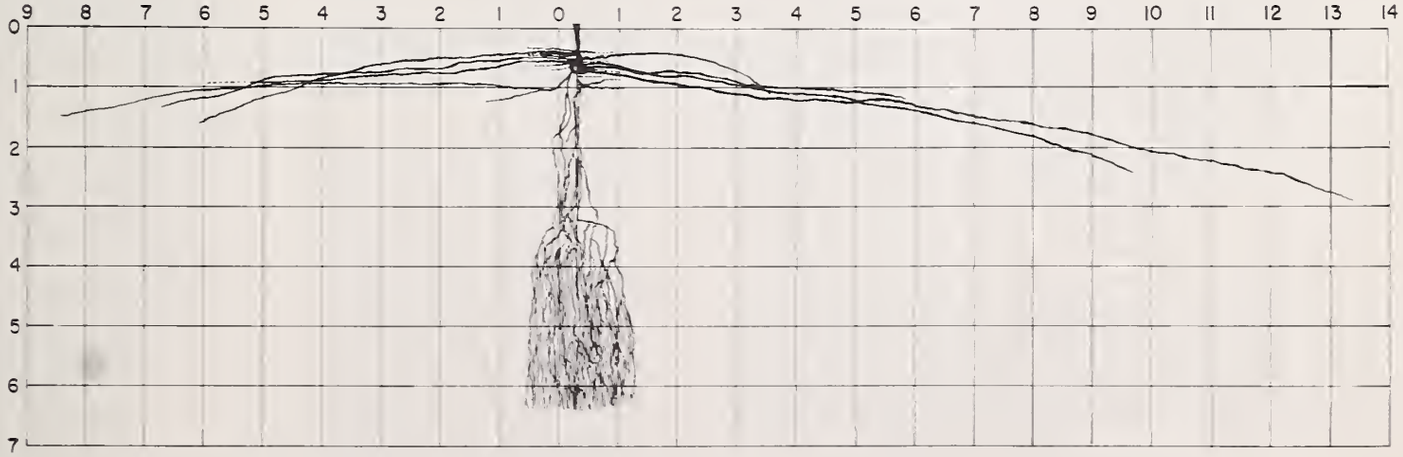

Figure 3.--Vertical projection of root system of 4-season ponderosa pine. Grid units are feet.

Perhaps the impressive root growth made by these trees on a cultivated soil cannot be duplicated on many forest soils. But one thing is strikingly clear: ponderosa pines can extend their roots very rapidly in good soils that are free of competing vegetation.

Experience and research have demonstrated repeatedly that site preparation is necessary to permit successful forestation of heavily vegetated sites. Site preparation has frequently consisted of merely scalping the vegetation from planting spots 1 to 2 feet in diameter. Scalped spots sufficiently large to permit these trees to grow free of root competition for only 2 years would have been 14 feet across. Trees are commonly planted more closely than that in forest plantations.

The implication is this: if planted ponderosa pines are to be given maximum opportunity to grow free of competition through the seedling and sapling stages, and to escape quickly from the many enemies that threaten small trees, competing vegetation must be removed from the entire planting area.